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Risk in Output Growth of Oilseeds in the Rajasthan State: A Policy Perspective

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Abstract

Today, India is one of the largest producers of oilseeds in the world and this sector occupies an important position in the agricultural economy. Rajasthan state occupies a prominent place in the oilseeds production of India. The important oilseed crops of the Rajasthan state are groundnut, soyabean, rapeseed & mustard, sesamum and taramira. The growth pattern of these crops in the state has been prone to risk over time and across the agro-climatic regions because of the rainfall behaviour, prolonged drought-periods, limited water-resources and facilities available in the state Under such a situation, growth performances of these crops are subjected to high degree of risks in the sector. Therefore, it is important to describe the growth pattern of area, production and productivity, factors affecting acreage allocation under crops and magnitude of instability as well as its sources in major oilseeds crops of Rajasthan state. The fluctuating yield has been seen for almost all the oilseeds crops. However, the area and yield instability of the mustard crop has been found declining overtime plausibly because of increase in irrigation facilities, location-specific technologies and better input management. However, this needs to be further strengthened for improvement in the overall agricultural scenario. The acreage of the crops has been found to be governed by both price and non-price factors. Hence, price incentive alone has not been found to be the sufficient in bringing the desirable change in the cropping pattern as well production of crops. Hence, a policy for better implementation of support price system, development of consistently performing varieties and further enhancement of irrigation facilities will go a long way to ensure stability in the Rajasthan agriculture. To compel the large yield variability, it is advisable to the farmers to avail benefits of crop insurance scheme.

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Introduction

Agriculture is the most important sector of the Indian economy from the perspective of poverty alleviation, income and employment generation. Indian agriculture is characterized by varied agro-climatic situations, availability of resources and market structure. In India, agriculture is the main source of livelihood for the majority of people. The performance of the agricultural sector has enormous impact on the livelihood of the people, but it is subjected to various kinds of risks. These risks are related mainly to climate, inputs, outputs and prices. The degree of risk depends on the personal characteristics of farmers and probabilities of an event. Therefore, the degree of risk involved in any enterprise is affected by the farmers' decisions of acreage allocation and the growth performance of farm economy.

Oilseed crops have traditionally been the backbone of agricultural economy of India. Today, India is one of the largest producers of oilseeds in the world. It accounted for an estimated production of 25.14 million tonnes of nine cultivated oilseeds during the year 2003-04. India contributes about 8-9 per cent of the world oilseeds production. The stae of Rajasthan occupies a prominent place in the production of oilseeds in India as the area under these crops is 12.8 per cent of the total area of nearly 24.01 million hectares in the country. The state contributed around 13 per cent to country's oilseeds production in 2002-03. The important oilseed crops of the Rajasthan state are groundnut, soyabean, rapeseed & mustard, sesamum and taramira.

The growth pattern of these crops in the Rajasthan state has been prone to risk over time and across the agro-climatic regions because of the rainfall pattern, prolonged drought-periods and limited water-resources. The facilities available in the state are neither equally distributed nor fully dependable. Under such a situation, the growth performances of these crops are subjected to high degree of risks in the sector. Due to various kinds of risks, the sector may impede the economic growth of the country / region in two ways. Firstly, the production instability tends to destabilize the markets and may cause wide fluctuations in prices. It adversely affects that section of farmers who spend a higher proportion of their income on these items. It also forces the producer to sell their produce at cheaper rates to meet out the adverse impact of negative fluctuations. Secondly, fluctuation in prices leads to instability in production itself that in turn, may result in misallocation of inputs. Therefore, success of any policy action for agricultural growth depends on measurement of instability, identification of its broad sources and means to stabilize the growth process. The present paper describes the growth pattern of area, production and productivity, factors affecting acreage allocation under oilseed crops and magnitude of instability as well as its sources in major oilseed crops of the Rajasthan state.

Methodology

The oilseeds crops selected for the study were: goundnut, soyabean, rapeseed & mustard, sesamum and taramira, as these play a very important role in the farm economy of the state. The criteria applied for the identification of crops was that it should have an average area of at least two lakh hectares during the last five years (1996-97 to 2000-01). Rajasthan is a vast state where large variations in the pattern of agricultural development are displayed from district to district. The selected crops are not grown in all the districts of the state because of its varied agro-climatic conditions. Since aggregate analysis may not depict a true picture, a few important and potential districts were identified. The criterion applied for it was that the district should have accounted for 50 per cent share in the total area under a particular crop in the Rajasthan state. The selected districts are given in Table 1.

Table 1. The districts selected for different crop

Crops	Districts
Sesamum	Pali, Jodhpur and Nagaur
Groundnut	Jaipur, Chittorgarh, Swaimadhopur and Bikaner
Soyabean	Kota and Jhalawar
Rapeseed & mustard	Sri Ganganagar, Bharatpur, Alwar, Swaimadhopur and Tonk
Taramira	Nagaur, Bikaner and Pali

The secondary data regarding area, production and productivity of the selected crops and their competing crops, farm-harvest prices of selected and competing crops, seasonal rainfall, irrigated area under these crops in the selected districts and the state were collected for the period 1981-82 to 2000-01. The exponential forms of the compound growth rates of area, production and productivity of crops were calculated. Nerlovian lagged adjustment model was used for the analysis of acreage response function considering only price as an independent variable as given in Eqs (1)-(3):

$$A_t^* = C_0 + C_1 P_{t-1} + U_t \quad \ldots(1)$$

$$A_t - A_{t-1} = k (A_t^* - A_{t-1}) \quad \ldots(2)$$

$$A_t = b_0 + b_1 A_{t-1} + b_2 P_{t-1} + V_t \quad \ldots(3)$$

Equation (1) shows the behavioural relationship stating that the desired acreage (A_t^*) depends on one year lagged relative price (P_{t-1}). Equation (2) is the area adjustment equation in which k is coefficient of adjustment and Eq. (3) is the reduced form of observed area (A_t) in place of unobserved area (A_t^*) and relative lagged price. The coefficient of Eq. (3) is given in terms of adjustment coefficient (k) as Eq. (4):

$b_0 = C_0 k$; $b_1 = (1 - k)$; $b_2 = C_1 k$ and $V_t = U_t k$ …(4)

Both price (own and competing crop) as well as non-price factors (yields, risks, available irrigation facilities, rainfall, etc.), which affect farmers' decisions regarding area allocation to a particular crop were studied. This framework of the model does not change on including more independent variables in it. The final form of model is given in Eq. (5):

$$A_t = b_0 + b_1 LPSC + b_2 LASC + b_3 LYSC + b_4 YRSC + b_5 PRSC + b_6 LYCC + b_7 LPCC + b_8 RF\_IRR + b_9 DD + \ldots\ldots\ldots + Vt \quad \ldots(5)$$

where,

A_t = Current year area under study crop;

LPSC = One year lagged price of the study crop deflated by CPI for agricultural labour ;

LASC = One year lagged area of the study crop;

LYSC = One year lagged yield of the study crop;

YRSC = Yield risk of the studied crop measured by standard deviation of three preceding years;

PRSC = Price risk of the studied crop measured by standard deviation of three preceding years;

LYCC = Lagged yield competing crop;

LPCC = One year lagged competing crop price deflated by CPI for agricultural labour;

RF_IRR = Seasonal rainfall and/or irrigated area under study crop;

DD = District dummy;

V_t = Error-term;

The log linear form of acreage response function was estimated through ordinary least square method.

The instability in area, production and productivity of the selected crop was measured by estimating the coefficient of variation from the de-trended series of production, area and yield. To find the major contributor to production instability, the production variance was decomposed into its sources, viz. area variance, yield variance, area-yield covariance and higher-order interaction between area and yield by using the technique given by Hazell (1982) (Eq. (6)]:

$$V(Q) = \bar{A}^2 V(Y) + \bar{Y}^2 V(A) + 2\bar{A}\bar{Y} COV(A,Y) - COV(A,Y)^2 + R \quad \ldots(6)$$

where,

$V(Q)$	=	Production variance
$\bar{A}$	=	Mean area
$\bar{Y}$	=	Mean yield
$V(Y)$	=	Yield variance
$V(A)$	=	Area variance
$COV\ (A,Y)$	=	Area-yield covariance
$COV(A,Y)2$	=	Higher-order covariance between area and yield
R	=	Residual-term

Results and Discussion

The growth pattern in area and yield of crops depicted its performance over a period. The combination of area and yield growth (positive and/or negative) with the yield status (high- or low-yielding districts in comparison to average yield of the state) indicated the performance of crop. Promising district is the one which has been transformed from low-yielding and negative yield-growth of crops to high-yielding with positive yield-growth and low-yielding with positive yield-growth, and from low-yielding with positive yield-growth to high-yielding with positive yield-growth of crops under consideration. The promising and losing districts for each selected oilseeds crops have been presented in Table 2.

The yield and area growth rate of groundnut in all the selected districts showed a positive yield-growth during the Period II, except in Chittore. The yield growth of groundnut was negative in both the periods. However, the area growth of groundnut turned negative during Period II, except in the Jaipur district. Therefore, Chittore was a losing district for groundnut cultivation. The compund growth rate of area, production and productivity of groundnut in the state was 1.87, 4.37 and 2.46 per cent per annum, respectively during the study period. Soyaben crop emerged as a highly promising crop after its introduction in the state in 1983-84. Its growth rate of area, production and productivity was 21.97, 24.71 and 2.25 per cent during the overall period. However, out of the two major growing districts, Kota exhibited a promising trend for the cultivation this crop during both the periods. The sesamum crop depicted a losing trend in all the selected districts as both area and yield growth turned out to be negative during the Period II. The decline in area was found statistically significant. The rapeseed and mustard is the most important oilseed crop of the Rajasthan state. It is grown on 2072 thousand hectares, yielding 1998 thousand tonnes. Out of

Table 2. Growth pattern of area and yield of oilseed crops

Particulars	Yield growth		Area growth	
	Positive	Negative	Positive	Negative
		Groundnut		
		Period I		
Low yield	Jaipur	Sawai Madhopur	Jaipur, Sawai Madhopur	-
High yield	Bikaner	Chittore	Bikaner, Chittore	-
		Period II		
Low yield	Sawai Madhopur	-	-	Sawai Madhopur
High yield	Jaipur, Bikaner	Chittore	Jaipur	Bikaner, Chittore
		Soyabean		
		Period I		
Low yield	Jhalawar	-	Jhalawar	-
High yield	Kota	-	Kota	-
		Period II		
Low yield	-	Jhalawar	Jhalawar	-
High yield	Kota	-	Kota	-
		Sesamum		
		Period I		
Low yield	Jodhpur, Nagaur	-	Jodhpur, Nagaur	-
High yield	Pali	-	Pali	-
		Period II		
Low yield	-	Jodhpur, Pali	-	Jodhpur, Pali
High yield	-	Nagaur	-	Nagaur
		Rapeseed & Mustard		
		Period I		
Low yield	-	Sawai Madhopur, Tonk	Sawai Madhopur, Tonk	-
High yield	Alwar, Bharatpur, Ganganagar	-	Alwar, Bharatpur, Ganganagar	-
		Period II		
Low yield	Tonk	Sawai Madhopur	Tonk	Sawai Madhopur
High yield	Alwar, Bharatpur, Ganganagar	-	-	Alwar, Bharatpur, Ganganagar
		Taramira		
		Period I		
Low yield	-	Bikaner	Bikaner	-
High yield	Pali	Nagaur	Pali	Nagaur
		Period II		
Low yield	-	Pali	Pali	-
High yield	Bikaner	Nagaur	Bikaner, Nagaur	-

Low yield: If yield of crop in a district is less than the state average during TE of respective period

High yield: If yield of crop in district is more than the state average during TE of respective period

the five studied districts, four were found promising, as it yield growth was positive during Period II. Sawaimadhopur district exhibited a losing trend in both the periods. However, area growth was negative in all the districts, except in Tonk during the Period II. In the overall period, the compound growth rate of area, production and productivity was 7.8, 8.95 and 1.07 per cent per annum; the growth rate of area and production was also found statistically significant.

The supply response function describes factors considered by farmers while deciding about area to be put under the crop(s). The farmers allocate land to different crops depending on their prices and yields, availability of water and the risks involved. The coefficients of lagged price, lagged area and lagged yield of groundnut and rainfall were found to be positively affecting the significant factors (Table 3). The coefficients of dummy variables were found significant in the districts of Sawaimadhopur and Bikaner, indicating immeasurable district attributes for area allocation under groundnut.

Acreage response function of soyabean implies that the lagged acreage of the crop, the intensity of pre-sowing rainfall in the region and the price risk were the significant factors affecting the decision of farmers to allocate the area under soybean. The rainfall was negatively affecting the acreage while the previous year's acreage and the price risk had negative effect on the area under the crop, implying that low fluctuation in the crop price will lead to fluctuations in production (Table 4). The sesamum crop is mainly a rainfed crop. Table 5 shows that the area under sesamum had positive and significant relation with lagged price and lagged yield of sesamum, as well as with lagged price of the competitive crop, viz. moong. Price risk of sesamum was found negatively affecting the acreage allocation.

Table 3. Acreage response function of groundnut in Rajasthan

Particulars	Coefficient	Standard error
Constant	– 4.30	1.111
Lagged price of groundnut	0.48**	0.151
Lagged area of groundnut	0.70**	0.048
Lagged yield of groundnut	0.26**	0.070
Rainfall	0.13*	0.062
Dummy for		
Chittore	–0.15	0.080
Sawai Madhopur	– 0.16*	0.074
Bikaner	– 0.27**	0.109
R^2	0.92	
Adjusted R^2	0.92	

** and * denote significance at 1 and 5 % levels of probability, respectively

The acreage allocation under rapeseed and mustard was governed by both price and non-price factors. The lagged price of mustard, lagged area under rapeseed & mustard and availability of irrigation to crop were significantly and positively influencing the factors for allocating area under this crop. Price risk of mustard was found negatively affecting the acreage allocation; however, it was not statistically significant. The positive sign of district dummy variables by taking Sri Ganganagar as the base, indicated the importance of mustard area in farm economy of districts under study (Table 6). Lagged area under taramira, lagged yield of the competing crop, and sowing season rainfall were observed as significant variables, positively influencing the area allocation to taramira crop. The unexpected positive

Table 4. Acreage response function of soyabean in Rajasthan

Particulars	Coefficient	Standard error
Constant	4.62	1.216
Lagged price of soyabean	– 0.32	0.217
Lagged area of soyabeen	0.76**	0.106
Lagged price of competitive crop	0.44	0.248
Price risk of soybean	– 0.19**	0.055
Rainfall	– 0.70**	0.207
Dummy for		
Jhalawar	0.18	0.156
R^2	0.91	
Adjusted R^2	0.87	

** and * denote significance at 1 and 5 % levels of probability, respectively

Table 5. Acreage response function of sesamum in Rajasthan

Particulars	Coefficient	Standard error
Constant	– 11.22	4.064
Lagged price of sesamum	0.45	0.306
Lagged area of sesamum	0.72**	0.134
Lagged yield of sesamum	0.09**	0.036
Lagged price of competing crop	1.64**	0.487
Price risk of sesamum	– 0.17*	0.075
Yield risk of sesamum	– 0.08	0.050
Rainfall	0.02	0.047
Dummy for		
Jodhpur	– 0.21	0.138
Nagaur	– 0.13	0.113
R^2	0.71	
Adjusted R^2	0.66	

** and * denote significance at 1 and 5 % levels of probability, respectively

Table 6. Acreage response function of rapeseed and mustard in Rajasthan

Particulars	Coefficient	Standard error
Constant	-1.10	0.737
Lagged price of mustard	0.35**	0.115
Lagged area of mustard	0.43**	0.045
Price risk of mustard	-0.03	0.019
Irrigated area of mustard	0.40**	0.047
Dummy for		
Bharatpur	0.37**	0.079
Alwar	0.18**	0.062
Sawai Madhopur	0.21**	0.067
Tonk	0.18*	0.075
R^2	0.95	
Adjusted R^2	0.94	

** and * denote significance at 1 and 5 % levels of probability, respectively

sign of lagged yield of the competing crop shows that the area under taramira increased despite increasing yield of competing crop, because the taramira required less input than the competing crop. Yield risk of taramira was found negatively affecting the acreage allocation, however, it was not statistically significant. The significant and positive sign of seasonal rainfall pointed out the importance of seasonal rainfall in the study area. If there is some rainfall during the sowing season, the rainfed area is allocated to taramira crop. Negative sign of district dummy variables indicated less area under taramira in Bikaner and Pali compared to the base district of Nagaur.

The lagged price variable was found to be positive in seasamum, groundnut, rapeseed & mustard, and taramira, except soyabean. The short-run elasticity shows the acreage responsiveness of a crop to price changes during the immediate succeeding crop period. The short-run elasticity for these crops ranged from –0.32 to 0.832. It may be noted that the negative supply response is not an uncommon feature on supply response as indicated in many earlier studies (Sud and Kahlon, 1969; Cumming, 1975; Jhala, 1979; Krishna and Rao, 1965 and 1967; Bhowmick and Goswami, 1998). The long-run elasticity reflects the acreage responsiveness of a crop to price change given the sufficient time for adjustment. Sesamum, groundnut and taramira showed very high long-run elasticity. The impact of price policy instrument on these crops would be substantial in the long-run. The number of years required for price effect to materialize depends on the technological and institutional constraints faced by the farmers for a particular crop. The higher the constraints, the more is the time needed for adjustment. It was observed that crops like soyabean, sesamum and groundnut took substantially large time for adjustment.

Table 7. Acreage response function of taramira in Rajasthan

Particulars	Coefficient	Standard error
(Constant)	– 12.36	8.490
Lagged price of taramira	0.84	1.313
Lagged area of taramira	0.27*	0.127
Lagged yield of competing crop	1.41*	0.617
Yield risk of taramira	– 0.34	0.256
Rainfall	0.53**	0.120
Dummy for		
Bikaner	– 2.26**	0.640
Pali	-0.14	0.492
R^2	0.59	
Adjusted R^2	0.51	

** and * denote significance at 1 and 5 % levels of probability, respectively

Table 8. Short-run and long-run price elasticities of area under various crops in Rajasthan

Crops	Short-run elasticity	Long-run elasticity	Number of years required for price effect to materialize
Sesamum	0.45	1.57	9.00
Groundnut	0.48	1.59	8.47
Soyabean	– 0.32	-1.31	10.66
Mustard	0.353	0.621	3.57
Taramira	0.839	1.154	2.31

The combination of growth rate and instability together gives a meaningful interpretation about the growth pattern and directly reveals the policy direction to enhance the crop performance. The level and magnitude of instability in the area and yield for a particular crop in the district was compared with the results of state level data to define the districts in different categories. If the magnitude of instability in a district is more than that of the state, then the district is called more instable and vice versa. The district showing change from more instable to less instable and with positive growth rate in terms of yield is called promising district for the production of crop. The second criterion for being promising district is that it should exhibit status quo and less instability during both the periods with the positive yield growth. Positive growth in yield of a crop contributes to the sustainable growth in production.

Due to concerted efforts of the Technology Mission on Oilseeds, there has been a phenomenal increase in oilseeds production during the past two decades. However, very high percentage of area under oilseeds in the state still depends on rainfall; therefore, the oilseeds production has possibility of

high instability from year to year. Groundnut production instability was found to be increasing over time in the state because of erratic rainfall during Period II. The districts of Jaipur, Bikaner and Sawai Modhopur have shown more instability with positive growth in yield of groundnut during Period II. The Chittore district was worse as less yield instability with negative growth turned into more instability with negative yield-growth during Period II. The production instability of soyabean increased in the Kota district as well as for the Rajasthan state. But the Jhalawar district showed a declining production instability. Sesamum was observed as losing, as all the districts showed declining yields and status quo high instability in terms of area and yield. The production instability of rapeseed and mustard crops was found to be less (around 19 per cent) as compared to other oilseeds in the Rajasthan state. Yield of mustard crop exhibited more instability in all the districts during both the periods. The production instability of taramira crop was increasing over time in all the districts as well in the state (Table 9 and Appendix II). Area and yield instability of taramira was high in all the districts in comparison to state. Taramira is a remunerative crop in the unirrigated area; its yield and area were dependent on seasonal rainfall.

It is essential to identify the risk-inducing factors, viz. sources of production instability. These sources were quantified by decomposing the variance of production into the various sources, i.e. area variance, yield variance, area-yield covariance and higher order interaction between area and yield. The major contributing factor in production variance of groundnut was yield variance in all the districts except Bikaner. The yield variance declined over time in the study area except in Sawai Madhopur. Area variance emerged as the major contributing factor in production variance during both the periods in Kota district. Jhalawar district experienced production instability due to high-yield variance during both the periods. The share of yield variance in production instability increased over time in the Jhalawar district. Yield variance constituted a large share in production variance of sesamum. Therefore, yield risk minimizing policy may be devised so as to boost the production of sesamum crop in the state. During Period I, area variance was observed to be the dominating factor in production variance of rapeseed & mustard in all the districts as well as in the state. During Period II, production variance was caused by both area variance and yield variance. In the districts of Alwar, Bharatpur and Swai Madhopur, yield variance emerged as the major component of production variance, whereas in Sri Ganganagar and Tonk and in state as a whole, area variance was observed to be the major source of production variance. Area variance was the major source of production variance of taramira crop in the study area during both the periods because area under taramira depended on seasonal rainfall.

Table 9. Instability in area and yield of oilseeds

Yield growth	Yield		Area	
	More instable	Less instable	More instable	Less instable
		Groundnut		
		Period I		
Positive	Jaipur, Bikaner	-	Jaipur, Bikaner, Swai Madhopur, Chittore	-
Negative	Swai Madhopur	Chittore	-	-
		Period II		
Positive	Bikaner, Jaipur, Swai Madhopur	-	Jaipur	-
Negative	Chittore	-	Bikaner, Swai Madhopur	Chittore
		Soybean		
		Period I		
Positive	Jhalawar	Kota	Kota, Jhalawar	-
Negative	-	-	-	-
		Period II		
Positive	Kota	-	Kota	-
Negative	Jhalawar	-	-	Jhalawar
		Sesamum		
		Period I		
Positive	Jodhpur, Nagaur, Pali	-	Jodhpur, Nagaur	Pali
Negative	-	-	-	-
		Period II		
Positive	-	-	-	-
Negative	Jodhpur, Nagaur, Pali	-	Jodhpur, Nagaur, Pali	-
		Rapeseed & Mustard		
		Period I		
Positive	Alwar, Bharatpur, Ganganagar	-	-	Alwar, Bharatpur, Ganganagar
Negative	Swai Madhopur, Tonk	-	Swai Madhopur, Tonk	-
		Period II		
Positive	Alwar, Bharatpur, Tonk, Ganganagar	-	Ganganagar, Tonk	Alwar, Bharatpur,
Negative	Swai Madhopur	-	-	Swai Madhopur
		Taramira		
		Period I		
Positive	Pali	-	Pali	-
Negative	Bikaner, Nagaur	-	Bikaner, Nagaur	-
		Period II		
Positive	Bikaner	-	Bikaner	-
Negative	Nagaur, Pali	-	Nagaur, Pali	-

More instability: If instability in district is more than that in the state as a whole for crop
Less instability: If instability in district is less than that in the state as a whole for crop

Table 10. Sources of variance of production of kharif oilseeds

(in per cent)

Particulars	C.V. of production	Area variance	Yield variance	Area yield covariance	Higher order covariance
		Groundnut			
		Period I			
Jaipur	37.92	25.39	52.76	21.95	-0.11
Swai Madhopur	51.96	15.76	52.75	16.91	14.58
Bikaner	50.22	20.32	51.19	14.79	13.7
Chittore	23.63	26.48	81.11	-5.95	-1.64
Rajasthan	20.1	31.88	115.92	-34.84	-12.96
		Period II			
Jaipur	42.08	19.7	49.48	17.53	13.29
Swai Madhopur	41.3	31.75	62.71	20.25	-14.71
Bikaner	25.02	67.63	55.05	-10.78	-11.89
Chittore	18.7	31.57	78.97	-10.23	-0.31
Rajasthan	27.03	8.53	60.11	26.98	4.38
		Soyabean			
		Period I			
Kota	19.94	189.31	52.55	-114.57	-27.29
Jhalawar	65.55	32.54	75.76	31.52	-39.83
Rajasthan	20.08	113.38	66.1	-49.91	-29.57
		Period II			
Kota	39.72	41.45	37.24	6.44	14.87
Jhalawar	30.38	6.63	95.12	-1.14	-0.6
Rajasthan	27.6	24.32	54.37	12.38	8.93
		Sesamum			
		Period I			
Jodhpur	108	7.05	78.86	17.42	-3.33
Nagaur	80.78	17.61	66.61	28.79	-13.01
Pali	72.46	7.77	82.97	15.77	-6.51
Rajasthan	66.97	12.49	68.02	28.12	-8.63
		Period II			
Jodhpur	94.98	3.86	74.82	6.6	14.7
Nagaur	51.66	18	53.69	17.37	10.94
Pali	70.21	8.41	63.92	17.56	10.1
Rajasthan	38.76	19.05	88.33	-6.12	-1.26

Conclusions

The state of Rajasthan has a characteristic feature of erratic and unevenly distributed low rainfall. This is also reflected by the crop

Table 11. Sources of variance of production of rabi oilseeds

(in per cent)

Particulars	C.V. of production	Area variance	Yield variance	Area yield covariance	Higher order covariance
		Rapeseed & mustard			
		Period I			
Alwar	14.89	67.58	39.72	-1.53	-5.76
Bharatpur	23.17	36.64	36.58	22.44	4.34
Swai Madhopur	35.02	42.74	34.1	25.54	-2.38
Ganganagaer	21.49	63.63	46.64	-5.51	-4.76
Tonk	47.23	57.72	21.94	9.82	10.52
Rajasthan	19.01	96.37	10.56	-4.03	-2.9
		Period II			
Alwar	18.24	15.93	67.66	13.98	2.44
Bharatpur	19.84	20.76	85.28	-6.97	0.93
Swai Madhopur	18.05	72.81	76.95	-48.37	-1.39
Ganganagaer	28.72	43.31	30.58	28.92	-2.81
Tonk	29.29	49.97	44.36	4.95	0.72
Rajasthan	19.03	75.45	33.21	-8.42	-0.25
		Taramira			
		Period I			
Bikaner	115.02	399.62	29.74	-113.98	-215.38
Nagaur	138.81	16.26	51.97	9.74	22.03
Pali	106.47	126.31	21.24	-4.68	-42.87
Rajasthan	37.11	113.95	78.54	-46.34	-46.15
		Period II			
Bikaner	191.95	74.6	3.35	4.65	17.4
Nagaur	166.5	149.05	8.8	-27.92	-29.93
Pali	130.57	152.39	13.53	-20.04	-45.87
Rajasthan	105.88	104.76	1.47	-6.16	-0.07

performance during the *kharif* season, and fluctuating yield levels have been observed for almost all the oilseeds crops. The efforts are needed for the development of crop varieties and technologies that can perform better under such conditions. In addition, the policy of price support is required to be broadened to include more realistic estimates for the oilseed crops. The area and yield instability of the mustard crop has been found declining overtime plausibly because of increase in irrigation facilities, location-specific technologies and better input management. However, this needs to be strengthened further for improvement in overall agricultural scenario. It has been observed that the acreage of the crops is governed by both price and non-price factors. Hence, price incentive alone has not been found to be

sufficient in bringing the desirable changes in the cropping pattern as well production of crops. The non-price factors like yield risk, yield of own and competing crops, rainfall and irrigation facilities, examined under the study, have been found as the relevant explanatory variables. Hence, a policy for better implementation of support price system, development of consistently performing varieties and further enhancement of irrigation facilities will go a along way to ensure stability in the Rajasthan agriculture. It has been observed that in most of the crops, yield variability is more, therefore it is advisable for the farmers to avail benefits of crop insurance scheme launched by the government to establish their returns. Also, the government should announce insurance scheme for those crops for which there is no insurance cover as yet.

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Appendix I

Compound growth rates of area, production and productivity of crops

(per cent per annum)

Districts	Period I[1]			Period II[2]			Overall[3]		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
Sesamum									
Jodhpur	1.42	20.16	18.52	-13.62 *	-35.02	-23.72	0.35	3.89	7.13
	(9.65)	(52.74)	(59.94)	(5.49)	(24.66)	(26.60)	(4.09)	(17.39)	(17.19)
Nagaur	5.51	7.7	3.25	-23.78**	-33.07**	-12.15	-4.53	-0.21	4.61
	(11.6)	(57.53)	(46.28)	(4.87)	(10.95)	(10.76)	(5.4)	(15.42)	(12.04)
Pali	2.23	22.79	19.55	-9.44 *	-28.16	-20.05	-1.32	-3.96	-2.23
	(6.04)	(45.54)	(44.94)	(4.26)	(21.01)	(21.31)	(2.51)	(12.74)	(11.84)
Rajasthan	-0.39	7.55	8.02	-11.44**	-17.28	-6.58	-2.4	-0.53	1.96
	(7.54)	(29.49)	(24.99)	(3.23)	(9.85)	(9.98)	(2.73)	(8)	(6.44)
Groundnut									
Jaipur	3.3	4.73	1.39	4.85	13.51	8.26	6.37**	10.92**	4.28
	(5.56)	(11.41)	(7.86)	(4.94)	(11.86)	(9.22)	(1.94)	(4.16)	(2.97)
Swai	0.8	-1.65	-2.43	-1.65	6.88	8.67	-0.98	1.03	2.03
Madhopur	(5.82)	(12.97)	(10.21)	(6.66)	(16.29)	(13.07)	(2.1)	(4.94)	(4.11)
Bikaner	31.08 *	44.27**	11.85	-2.61	-0.31	2.27	14.31**	18.93**	4.78
	(11.71)	(15.08)	(13.61)	(5.57)	(7.43)	(5.08)	(5.42)	(6.95)	(3.54)
Chittore	5.39	5.16	-0.32	-5.88	-7.91	-2.14	-0.46	0.3	0.71
	(3.59)	(6.73)	(5.92)	(3.24)	(5.33)	(4.36)	(1.9)	(2.78)	(1.88)
Rajasthan	4.2	7.83	3.51	0.22	2.52	2.29	1.87	4.37 *	2.46
	(3.17)	(5.74)	(5.61)	(4.54)	(7.47)	(4.45)	(1.41)	(2.34)	(1.68)
Soyabean (1983-84 to 2000-01)									
Kota	34.16 *	37.68 *	2.63	13.97	15.13	1.02	18.46**	19.24**	0.66
	(12.91)	(12.58)	(6.06)	(9.15)	(12.36)	(7.97)	(4.41)	(5.25)	(2.58)
Jhalawar	72.73**	109.34	19.59	15.06**	14.85	-0.18	36.99**	51.39**	10.24
	(16.48)	(58.93)	(31.39)	(3.78)	(12.83)	(9.22)	(8.32)	(15.97)	(6.76)
Rajasthan	34.26**	41.31**	5.28	13.27 *	13.57	0.28	21.97**	24.71**	2.25
	(6.88)	(7.97)	(6.04)	(5.25)	(10.10)	(5.97)	(3.56)	(5.19)	(2.18)
Taramira (1983-84)									
Bikaner	10.18	6.8	-2.59	0.81	12.94	6.86	1.37	5.44	2.44
	(40.21)	(23.93)	(18.09)	(54.77)	(60.32)	(14.78)	(17.46)	(17.09)	(5.54)
Nagaur	-3.46	-17.01	-12.5	1.01	-0.62	-1.77	14.82	4.54	-8.52
	(43.8)	(46.48)	(25.02)	(45.18)	(39.76)	(9.67)	(18.56)	(16.81)	(5.68)
Pali	17.65	20.40	7	8.92	-9.1	-17.16 *	21.04	12.60	-3.69
	(62.21)	(52.42)	(21.98)	(35.05)	(27.96)	(7.82)	(16.57)	(14.83)	(5.98)
Rajasthan	-2.34	-1.49	0.79	-4.05	-13.57	-8.66 *	-2	-3.76	-1.94
	(13.28)	(15.32)	(11.55)	(23.47)	(19.91)	(3.28)	(7.42)	(7.51)	(2.92)
Rapeseed & mustard									
Alwar	12.45**	16.87**	3.85	-2.72	1.65	4.48	5.53 *	6.98**	1.34
	(3.92)	(4.55)	(2.48)	(1.96)	(5.19)	(4.47)	(2.31)	(2.66)	(1.46)

Contd

Appendix I *(Contd)*

Compound growth rates of area, production and productivity of crops

(per cent per annum)

Districts	Period I[1]			Period II[2]			Overall[3]		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
Bharatpur	10.78 *	13.07 *	3.16	-6.2 *	-3.07	3.33	2.8	3.32	0.83
	(4.26)	(6.87)	(4.05)	(2.66)	(5.85)	(5.9)	(2.6)	(3.02)	(1.8)
Swai	16.91 *	16.59	-0.14	-2.28	-4.47	-2.25	9.07**	8.2 *	-0.76
Madhopur	(8.42)	(12.4)	(5.23)	(4.33)	(4.93)	(4.36)	(3.49)	(4.27)	(1.63)
Ganganagar	13.25 *	16.1 *	3.86	-0.72	2.41	3.16	6.24 *	7.47 *	1.69
	(6.23)	(6.9)	(4.45)	(5.37)	(8.84)	(4.71)	(2.7)	(3.25)	(1.6)
Tonk	29.59	26.01	-3.8	2.68	6.52	3.73	16.59**	16.66**	0.64
	(17.42)	(19.61)	(6.43)	(5.55)	(9.07)	(6.81)	(5.42)	(5.54)	(2.45)
Rajasthan	11.81 *	14.97 *	2.8	-1.52	-0.17	1.38	7.8**	8.95**	1.07
	(4.95)	(5.56)	(1.64)	(4.97)	(5.68)	(3.1)	(2.67)	(2.88)	(0.9)

** and * denote significance at 1, and 5 per cent levels, respectively

[1] (1981-82 to 1990-91), [2] (1991-92 to 2000-01) and [3] (1981-82 to 2000-01)

Figures within the parentheses are standard errors

Appendix II

Magnitude of instability in area, production and productivity of crops

Particulars	Coefficient of variation		
	Period I	Period II	Overall
	Groundnut		
Jaipur			
Area	19.42	18.98	21.38
Production	37.92	42.08	46.60
Yield	28.00	30.08	31.01
Swai Madhopur			
Area	21.12	23.69	22.11
Production	51.96	41.30	46.83
Yield	38.64	33.29	36.00
Bikaner			
Area	23.08	20.50	33.96
Production	50.22	25.02	49.15
Yield	36.63	18.50	30.63
Chittore			
Area	12.14	10.49	19.08
Production	23.63	18.70	28.30
Yield	21.25	16.59	19.90
Rajasthan			
Area	11.27	16.85	15.13
Production	20.10	27.03	24.55
Yield	21.49	16.08	18.12

Contd

Appendix II (*Contd)*

Magnitude of instability in area, production and productivity of crops

Particulars	Coefficient of variation		
	Period I	Period II	Overall
	Soyabean		
Kota			
Area	26.83	25.70	30.46
Production	19.94	39.72	39.89
Yield	14.14	24.36	20.30
Jhalawar			
Area	40.34	7.82	22.10
Production	65.55	30.38	41.64
Yield	61.56	29.61	41.50
Rajasthan			
Area	21.17	13.68	20.35
Production	20.08	27.60	28.65
Yield	16.16	20.45	19.46
	Sesamum		
Jodhpur			
Area	32.39	19.26	42.75
Production	108.00	94.98	114.74
Yield	108.33	84.76	107.41
Nagaur			
Area	37.87	22.45	55.48
Production	80.78	51.66	104.68
Yield	73.66	38.77	65.78
Pali			
Area	21.11	21.33	29.56
Production	72.46	70.21	107.85
Yield	68.99	58.80	90.33
Rajasthan			
Area	25.38	16.84	30.35
Production	66.97	38.76	72.19
Yield	59.24	36.26	54.61
	Rapeseed & mustard		
Alwar			
Area	12.24	7.30	20.49
Production	14.89	18.24	23.11
Yield	9.38	15.04	15.56
Bharatpur			
Area	14.11	9.03	25.95
Production	23.17	19.84	30.25
Yield	14.10	18.30	17.93

Contd

Appendix II (*Contd)*

Magnitude of instability in area, production and productivity of crops

Particulars	Coefficient of variation		
	Period I	Period II	Overall
Swaimadhopur			
Area	23.26	15.28	26.93
Production	35.02	18.05	33.81
Yield	20.78	15.71	18.39
Ganganagar			
Area	17.12	19.13	23.11
Production	21.49	28.72	29.77
Yield	14.66	16.08	16.08
Tonk			
Area	36.29	20.75	28.28
Production	47.23	29.29	38.23
Yield	22.37	19.55	22.56
Rajasthan			
Area	18.65	16.51	24.45
Production	19.01	19.03	25.44
Yield	6.17	10.95	9.58
	Taramira		
Bikaner			
Area	153.09	183.12	207.46
Production	115.02	191.95	238.82
Yield	41.76	38.83	41.14
Nagaur			
Area	62.52	156.59	196.43
Production	138.81	166.50	294.12
Yield	111.78	38.05	133.78
Pali			
Area	116.65	140.31	168.16
Production	106.47	130.57	115.54
Yield	47.83	41.81	55.81
Rajasthan			
Area	38.43	104.86	87.15
Production	37.11	105.88	80.73
Yield	31.90	12.40	28.08